Text Solutions: Chapter 19, #1, 5, 7, 9, 11, 25, 27, 29, 31, 33

**1. Margin of error.**

He believes the true proportion of voters with a certain opinion is within 4% of his estimate, with some degree of confidence, perhaps 95% confidence.

**5. Conclusions.**

a) Not correct. This statement implies certainty. There is no level of confidence in the statement.

b) Not correct. Different samples will give different results. Many fewer than 95% of samples are expected to have *exactly* 88% on-time orders.

c) Not correct. A confidence interval should say something about the unknown population proportion, not the sample proportion in different samples.

d) Not correct. We *know* that 88% of the orders arrived on time. There is no need to make an interval for the sample proportion.

e) Not correct. The interval should be about the proportion of on-time orders, not the days.

**7. Confidence intervals.**

a) False. For a given sample size, higher confidence means a *larger* margin of error.

b) True. Larger samples lead to smaller standard errors, which lead to smaller margins of error.

c) True. Larger samples are less variable, which makes us more confident that a given confidence interval succeeds in catching the population proportion.

d) False. The margin of error decreases as the square root of the sample size increases. Halving the margin of error requires a sample four times as large as the original.

**9. Cars.**

We are 90% confident that between 29.9% and 47.0% of cars are made in Japan.

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**11. Ghosts.**

a) $ME = z^* \times SE(\hat{p}) = z^* \times \sqrt{\frac{\hat{p}\hat{q}}{n}} = 1.645 \times \sqrt{\frac{(0.38)(0.62)}{1012}} \approx 2.5\%$

b) The pollsters are 90% confident that the true proportion of adults who believe in ghosts is within 2.5% of the estimated 38%.

c) A 99% confidence interval requires a larger margin of error. In order to increase confidence, the interval must be wider.

d) $ME = z^* \times SE(\hat{p}) = z^* \times \sqrt{\frac{\hat{p}\hat{q}}{n}} = 2.576 \times \sqrt{\frac{(0.38)(0.62)}{1012}} \approx 3.9\%$

e) Smaller margins of error will give us less confidence in the interval.

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**25. First Lady.**

a) **Plausible independence condition:** The responses are likely to be independent.
**Randomization condition:** The respondents were randomly selected.
**10% condition:** 1005 adults are less than 10% of all U.S. adults.
**Success/Failure condition:** $n\hat{p} = 1005(0.52) = 523$ and $n\hat{q} = 1005(0.48) = 482$ are both greater than 10, so the sample is large enough.

Since the conditions are satisfied, we can use a one-proportion $z$-interval to estimate the proportion of U.S. adults who believe that Laura Bush better fits their idea of a First Lady.

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}\hat{q}}{n}} = (0.52) \pm 1.960\sqrt{\frac{(0.52)(0.48)}{1005}} = (48.9\%, 55.1\%)$$

We are 95% confident that between 48.9% and 55.1% of U.S. adults believe that Laura Bush better fits their idea of a First Lady.

b) **Plausible independence condition:** The responses are likely to be independent.
**Randomization condition:** The respondents were randomly selected.
**10% condition:** 1005 adults are less than 10% of all U.S. adults.
**Success/Failure condition:** $n\hat{p} = 1005(0.43) = 432$ and $n\hat{q} = 1005(0.57) = 573$ are both greater than 10, so the sample is large enough.

Since the conditions are satisfied, we can use a one-proportion $z$-interval to estimate the proportion of U.S. adults who believe Hillary Clinton better fits their idea of a First Lady.

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}\hat{q}}{n}} = (0.43) \pm 1.960\sqrt{\frac{(0.43)(0.57)}{1005}} = (39.9\%, 46.1\%)$$

We are 95% confident that between 39.9% and 46.1% of U.S. adults believe Hillary Clinton better fits their idea of a First Lady. The claim that half of U.S. adults think Hillary best fits the bill is unlikely. The interval doesn't contain 50%.

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**27. First Lady redux.**

**a)** The 95% confidence interval for the true proportion of all 18 to 29 year olds who prefer Clinton will be about twice as wide as the confidence interval for the true proportion of all U.S. adults, since it is based on a sample about one-fourth as large.

**b)** **Plausible independence condition:** The responses are likely to be independent.
**Randomization condition:** The respondents were randomly selected.
**10% condition:** 250 adults are less than 10% of all U.S. adults.
**Success/Failure condition:** $n\hat{p} = 250(0.62) = 155$ and $n\hat{q} = 250(0.38) = 95$ are both greater than 10, so the sample is large enough.

Since the conditions are satisfied, we can use a one-proportion $z$-interval to estimate the proportion of 18 to 29 year olds who believe Hillary Clinton better fits their idea of a First Lady.

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}\hat{q}}{n}} = (0.62) \pm 1.960\sqrt{\frac{(0.62)(0.38)}{250}} = (60\%, 68\%)$$

We are 95% confident that between 60% and 68% of 18 to 29 year olds believe Hillary Clinton better fits their idea of a First Lady.

**29. Deer ticks.**

**a)** **Plausible independence condition:** Deer ticks are parasites. A deer carrying the parasite may spread it to others. Ticks may not be distributed evenly throughout the population.
**Randomization condition:** The sample is not random and may not represent all deer.
**10% condition:** 153 deer are less than 10% of all deer.
**Success/Failure condition:** $n\hat{p} = 32$ and $n\hat{q} = 121$ are both greater than 10, so the sample is large enough.

The conditions are not satisfied, so we should use caution when a one-proportion $z$-interval is used to estimate the proportion of deer carrying ticks.

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}\hat{q}}{n}} = \left(\frac{32}{153}\right) \pm 1.645\sqrt{\frac{\left(\frac{32}{153}\right)\left(\frac{121}{153}\right)}{153}} = (15.5\%, 26.3\%)$$

We are 90% confident that between 15.5% and 26.3% of deer have ticks.

**b)** In order to cut the margin of error in half, they must sample 4 times as many deer. $4(153) = 612$ deer.

**c)** The incidence of deer ticks is not plausibly independent, and the sample may not be representative of all deer, since females and young deer are usually not hunted.

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**31. Graduation.**

**a)**

$$ME = z^* \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$0.06 = 1.645\sqrt{\frac{(0.25)(0.75)}{n}}$$

$$n = \frac{(1.645)^2(0.25)(0.75)}{(0.06)^2}$$

$$n \approx 141 \text{ people}$$

In order to estimate the proportion of non-graduates in the 25-to 30-year-old age group to within 6% with 90% confidence, we would need a sample of at least 141 people. All decimals in the final answer must be rounded up, to the next person.
(For a more cautious answer, let $\hat{p} = \hat{q} = 0.5$. This method results in a required sample of 188 people.)

**b)**

$$ME = z^* \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$0.04 = 1.645\sqrt{\frac{(0.25)(0.75)}{n}}$$

$$n = \frac{(1.645)^2(0.25)(0.75)}{(0.04)^2}$$

$$n \approx 318 \text{ people}$$

In order to estimate the proportion of non-graduates in the 25-to 30-year-old age group to within 4% with 90% confidence, we would need a sample of at least 318 people. All decimals in the final answer must be rounded up, to the next person.
(For a more cautious answer, let $\hat{p} = \hat{q} = 0.5$. This method results in a required sample of 423 people.)
Alternatively, the margin of error is now 2/3 of the original, so the sample size must be increased by a factor of 9/4. $141(9/4) \approx 318$ people.

**c)**

$$ME = z^* \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$0.03 = 1.645\sqrt{\frac{(0.25)(0.75)}{n}}$$

$$n = \frac{(1.645)^2(0.25)(0.75)}{(0.03)^2}$$

$$n \approx 564 \text{ people}$$

In order estimate the proportion of non-graduates in the 25-to 30-year-old age group to within 3% with 90% confidence, we would need a sample of at least 564 people. All decimals in the final answer must be rounded up, to the next person.
(For a more cautious answer, let $\hat{p} = \hat{q} = 0.5$. This method results in a required sample of 752 people.)

Alternatively, the margin of error is now half that of the original, so the sample size must be increased by a factor of 4. $141(4) \approx 564$ people.

**33. Graduation, again.**

$$ME = z^* \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$0.02 = 1.960\sqrt{\frac{(0.25)(0.75)}{n}}$$

$$n = \frac{(1.960)^2(0.25)(0.75)}{(0.02)^2}$$

$$n = 1{,}801 \text{ people}$$

In order to estimate the proportion of non-graduates in the 25-to 30-year-old age group to within 2% with 95% confidence, we would need a sample of at least 1,801 people. All decimals in the final answer must be rounded up, to the next person.
(For a more cautious answer, let $\hat{p} = \hat{q} = 0.5$. This method results in a required sample of 2,401 people.)